**Objectives**

* Describe how energy drives movement and change in the asthenosphere.

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.
2. Matter moves and changes to return a system to **equilibrium**.

5. **Temperature** is a measure of the movement of molecules. Higher temperature means molecules are moving faster.

1. When molecules move faster, the **density** of most substances decreases. Water is an anomaly because liquid water is more dense than ice.
2. **Buoyancy** causes materials to rise or fall due to the relative density of materials.

**PART 1: Background Notes**

Include anything here you may want to remember from the introduction to the activity.

**Part 2: Group Work**

|  |  |
| --- | --- |
| Table A. Causal Principles for Asthenosphere Circulation | |
| **Asthenosphere Convection** | **Causal Principles** |
| Less dense material rises because of gravity |  |
| Cold, denser material sinks |  |
| Radioactive decay and residual heat from deep within Earth |  |
| Sinking lithosphere pulls the plate toward the subduction zone |  |
| Oceanic lithosphere slowly cools |  |

|  |  |
| --- | --- |
| Table B. Causal Principles for Ocean Circulation | |
| **Thermohaline Circulation** | **Causal Principles** |
| Wind-driven currents move masses of water toward the poles |  |
| Mixing of cold bottom waters with warm surface waters |  |
| Solar radiation is more intense at the equator than the poles |  |
| Water becomes saltier through evaporation |  |
| Dense water sinks in the North Atlantic Ocean |  |

Comparing the asthenosphere to thermohaline circulation of the oceans, match the features of each and determine what causal principles are responsible for the aspect of the system.

|  |  |  |
| --- | --- | --- |
| Table C. Comparing the Asthenosphere and Ocean Circulation | | |
| **Asthenosphere** | **Thermohaline** | **Causal Principle** |
| Less dense material rises because of gravity |  |  |
| Cold, denser material sinks |  |  |
| Radioactive decay and residual heat from deep within Earth |  |  |
| Sinking lithosphere pulls the plate toward the subduction zone |  |  |
| Oceanic lithosphere slowly cools |  |  |

Consider how these two systems are different. In the table below, fill in what the differences are between the asthenosphere and oceans.

|  |  |  |
| --- | --- | --- |
| Table D. Differences Between Asthenosphere and Ocean Circulation | | |
| **Difference** | **Asthenosphere** | **Oceans** |
| Primary source of energy for movement |  |  |
| Density differences |  |  |

**Part 3 – Homework**

If you complete the group work, you may work on the homework **on your own.** This means your answers should be generally unique from other students’ answers. **Submit your homework using ANGEL**.

**Short Answer Questions**

* What is slab pull?
* Why is density important for slab pull?

**Conclusion Question:**

Was slab pull or convection a more important mechanism for moving tectonic plates 3 billion years ago?

Here’s some relevant information:

* Three billion years ago the earth’s interior was hotter than today because there was more radioactive material and original heat from the Earth’s formation 4.6 billion years ago.
* There were areas of oceanic lithosphere and continental lithosphere three billion years ago.
* Geologists have evidence that there was less continental lithosphere.
* There is evidence that the chemical composition of the oceanic and continental lithosphere were about the same as they are today.

Explain your reasoning.